STATE OF ILLINOIS
ILLINOIS COMMERCE COMMISSION

In the Matter of	:	
	:	
Metricom, Inc.	:	
	:	Docket No. 99-0138
Application for Certificate of Service Authority to provide high speed, nonswitched wireless data transmission telecommunications service	:	
	:	
Metricom, Inc.	:	Docket No. 00-0234
	:	
Petition for Declaratory Ruling that Article 13 of the Illinois Public Utilities Act is not applicable to Metricom and Metricom's Ricochet[2] network services	:	(Consolidated for purposes of hearing only)

DIRECT TESTIMONY OF MICHAEL I. DANIEL ON BEHALF OF METRICOM, INC.

Q: PLEASE PROVIDE YOUR NAME AND BUSINESS ADDRESS.

A: My name is Michael I. Daniel. My business address is 980 University Avenue, Los Gatos, California 60106.

Q: PLEASE PROVIDE THE NAME OF YOUR EMPLOYER AND IDENTIFY YOUR POSITION.

A: I am employed by Metricom, Inc. My position is Senior Staff Network Architect.

OFFICIAL FILE
I.C.C. DOCKET NO. 00-0234
Metricom Exhibit No. 1
Witness Daniel
Date 6/2/00 Reporter

Q: PLEASE BRIEFLY DESCRIBE YOUR EDUCATIONAL AND BUSINESS BACKGROUND.

A: I hold a Bachelor of Science and a Masters degree in Electrical Engineering from Georgia Institute of Technology.

I joined Metricom in March 1998 and, as Senior Staff Network Architect, am responsible for Network Architect of the high-speed Ricochet Wireless Mobile Network. In this role, I am also responsible for managing relationships with ISPs and vendors, and developing new technologies for future deployment. In addition, I act as a technical consultant to Metricom's Sales and Marketing department on network design for Authorized Ricochet Service Providers.

I have over 12 years of experience in the field of telecommunications and information technology. I have previously held technical positions at Chevron Information Technology Company and BellSouth. During my seven-year tenure at Chevron, I managed and implemented large-scale local and wide area network projects for Chevron's Operating Companies. Prior to Chevron I worked at BellSouth for three years as a co-op student in the Company's Microwave and Transmission Engineering Group while attending Georgia Institute of Technology (Georgia Tech).

Q: WHAT IS THE PURPOSE OF YOUR TESTIMONY IN THIS PROCEEDING?

A: The purpose of my testimony is to describe the Ricochet^2 network that Metricom will use to provide its proposed services in Illinois.

Q: HAVE YOU PREPARED AN EXHIBIT THAT PROVIDES A DESCRIPTION OF METRICOM'S RICOCHET^2 NETWORK?

A: Yes. Attached to this testimony as Exhibit 1 is a document entitled "Ricochet^2 Network Overview" Version 3.0. This document provides a detailed description of the Ricochet^2 network that Metricom will use to provide its service. Rather than restate that information here, I will provide a brief summary of the Metricom network and then highlight the few aspects of that network that are most relevant to the Commission's decision in this proceeding.

Q. COULD YOU PLEASE PROVIDE A SUMMARY OF THE METRICOM RICOCHET^2 NETWORK?

A. The first element of the Metricom Ricochet^2 network is the Ricochet modem. The 13-ounce Ricochet modem is about the size of a television remote control, and plugs directly into a desktop, laptop or PDA standard serial port or universal serial bus. Subscribers to the service can make modem connections anywhere within a coverage area.

The Ricochet modems communicate with Microcell Radios, which are shoe box-sized radio transceivers that are typically mounted to street lights or utility poles. The Microcell Radios require only a small amount of power from the street lights (connected with a special adapter) and are otherwise self-contained units. No other wiring or connections are necessary. Microcell Radios are placed approximately every quarter to one-half square mile in a checkerboard pattern. Each Microcell Radio employs 162

frequency-hopping channels, and uses a randomly selected hopping sequence. This allows for a very secure network, and enables many subscribers to use the network at the same time.

Metricom's mesh network architecture transmits these wireless communications at a frequency of 902-928 MHz. FCC regulations mandate that transmissions in this part of the unlicensed spectrum cannot occupy a particular channel for more than 400 milliseconds (ms); the service completes its typical transmission in 100 ms on any one channel. Each radio - including the user's modem connection - "spreads" its transmissions over 162 channels (each of which is 160 KHz wide) that are randomly selected using unique sequences; sequential data transfers never occur on the same channel. This random technique is called Frequency Hopping Spread Spectrum (FHSS).

The network service breaks up information and spreads data across the network in a number of different packets that are typically 500 bytes. For example, a 2,500-byte message might be broken into five smaller packets that each transmit in a pseudo random fashion on a different channel. The packets take full advantage of the mesh architecture and the large number of routing paths it provides at any one time. As a result, many different paths are taken by packets being sent across the network.

Within a 20 square mile radius, Metricom installs Wired Access Points, or WAPs, which connect the Microcell Radios to the Ricochet^2 Wide Area Network. The WAPs, which

are located on building tops or towers, collect and convert RF data packets into Internet Protocol ("IP") data packets for transmission. Each WAP and the Microcell Radios that report to it can support thousands of subscribers.

From the WAP, data is then transmitted through the T1 frame-relay connection to a Network Interface Facility ("NIF"). Metricom places one NIF in each of its geographic service areas. The NIFs provide the connection to the Internet Service Provider Networks, who bundle Metricom's services with their own Internet access services. These Internet Service Provider Networks include national Internet backbone providers, Internet Service Providers ("ISPs") and cable companies. (UUNET, MCI Worldcom)

Q. CAN YOU DESCRIBE THE DISTINCTION BETWEEN THE SERVICES THAT METRICOM WILL PROVIDE TO RICOCHET^2 USERS AND THE SERVICES THAT THE INTERNET SERVICE PROVIDER NETWORKS WILL PROVIDE?

A. As I have previously described, Metricom will provide Ricochet modem users with a communications path to the Ricochet Service Provider Gateway, which connects directly to the Internet Service Provider Networks. The Internet Service Provider Networks will bundle the Ricochet^2 network services with their own services such as E-Mail, access to the Internet and other Internet services as shown in the Service Provider Network block of diagrams 2 and 4. In summary, Metricom provides Ricochet^2 network users with the ability to contact Internet Service Provider Networks using wireless modems. Those Internet Service Provider Networks provide the Ricochet^2 network users with the functionality of the Internet.

Q. WILL METRICOM USE THE EXISTING SWITCHED NETWORK TO PROVIDE ITS SERVICES?

A. No. The path of a Ricochet^2 user's communication is through Metricom's wireless network and through Metricom's packet-switched frame relay backbone. Metricom does not use the existing switched network to provide its services. The only telecommunications facilities that may be used in the Ricochet^2 network are leased lines to connect the WAPs to the NIF or to connect the NIF to the Internet Service Provider Networks. Metricom, therefore, will not interconnect with local exchange carriers to provide its services.

Q. DOES THIS COMPLETE YOUR TESTIMONY?

A. Yes.

Exhibit 1

Ricochet Network Overview

Version 3.0

March 6, 2000

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1 Ricochet Network

Metricom's Ricochet Network is a nationwide mobile data service network, offering the fastest wireless data connections to the Internet for mobile professionals in small, medium, and large corporations and vertical integrators. Ricochet Network Service and its various components will be sold to a variety of information and data service providers that will bundle Ricochet Network Services with their own Internet services to provide remote wireless access to the Internet . These service providers include national Internet backbone providers, Internet Service Providers, cable providers and other communications companies hereafter referred to as Internet Service Provider Networks. Metricom requires its Internet Service Provider Networks to support Metricom's network standards and data transmission rates to insure a consistent level of performance across our network.

1.1 What is the Ricochet Network?

The Ricochet Network is a nationwide, wireless data-communication system. Unlike other wireless networks, the Ricochet Network is dedicated to data and does not share bandwidth with voice communication networks. This allows Metricom to provide services targeted specifically for the needs of data communications.

The Ricochet Network consists of microcell radios that route data in packets from one radio to another. The Ricochet Network technology is referred to as a "Microcellular Data Network" (MCDN). Because data is routed in packets, the Ricochet Network is called a "packet-switched" network. The Radio Frequency (RF) data packets are sent to Wired Access Points (WAPs).

The WAPs use specialized Ethernet-microcell radios to convert the RF data packets into Internet Protocol (IP) data packets so that the data can continue traveling on a Wide Area Network. The subscribers use Ricochet wireless modems to access the microcell radios that comprise the RF portion of the Ricochet Network.

1.2 Ricochet Network RF Technology

The Ricochet Network operates on both licensed and license-free radio-frequency bands. The two license-free frequency bands are the Industrial, Scientific, and Medical (ISM) 900 MHz and 2.4 GHz frequency bands. The ISM 900 MHz band is used by subscriber devices to communicate with the Ricochet microcell radios. The ISM 2.4 GHz band is used by microcell radios and ISM Ethernet microcell radios to pass data between one another. All of the Metricom hardware that operates on the ISM frequency bands complies with FCC Rule 15. The Ricochet microcell radios use digital spread-spectrum technology to operate in these license free bands.

1.3 How the Ricochet Network works with the Internet Service Provider Networks

The end-user has a Ricochet wireless modem that is connected to his or her computer. The Ricochet wireless modem accesses the Ricochet Network by communicating to microcell radios and/or Ethernet microcell radios within their RF range. The Ricochet wireless modem establishes a connection to the microcell radios using frequency-hopping digital spread spectrum technology.

To connect to the Ricochet Network, the end-user initiates a Point-to-Point Protocol (PPP) networking connection by entering a "PPP connection string." The "PPP connection string" is an MCDN reference name that is translated by the Metricom Name Server to determine the MCDN address of the device it references. This creates a virtual connection over the Ricochet Network to a Ricochet Service Provider Gateway that interfaces with the Internet Service Provider's Network. A router at the Internet Service Provider's Network completes the users' PPP networking connection.

The Ricochet Network provides seamless transport of user data from the Ricochet modem to the Internet Service Provider's Network. Although the Ricochet network uses a wired IP configuration, the user's data is encapsulated and tunneled "transparently" between the user's Ricochet modem and the Internet Service Provider's Network. Data is encapsulated in MCDN packets for transport over the Ricochet Network and then converted to IP packets. From the user's viewpoint, it appears that they are connected directly to the Internet Service Provider's Network.

The Internet Service Provider Network is responsible for terminating the subscribers virtual PPP connection, authenticating the user and providing an IP address to the user's Ricochet modem. The Internet Service Provider Network is responsible for providing Internet access and other Internet services such as e-mail, newsgroups, telephone dial-in access and Web hosting.

1.4 How the Ricochet Network provides Corporate VPN?

The Ricochet Network is able to support remote wireless access to a Corporate Virtual Private Network in conjunction with the Internet Service Provider Network. After a corporate Ricochet end-user has initiated a Ricochet wireless connection and has been authenticated, the end-user is able to connect to their corporate network through the Internet Service Provider Network. The Internet Service Provider Network will extend a virtual PPP connection to the end-user's corporate network via Internet connections to that company's network.

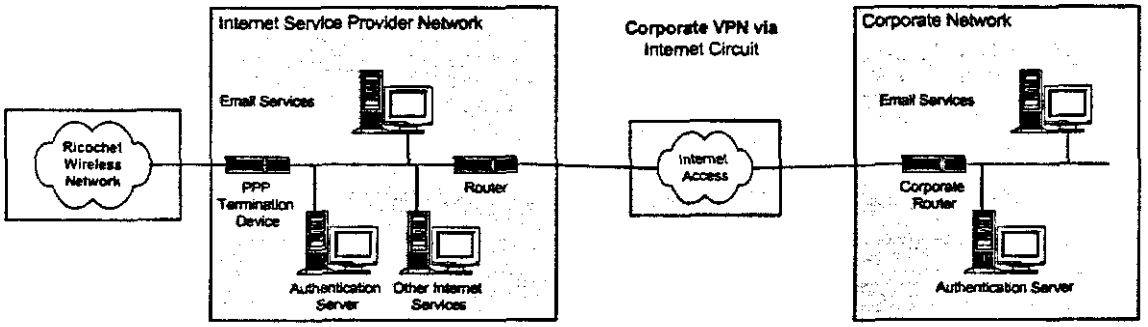

Figure 1: Corporate VPN Access

2 Ricochet Network GSA Architecture

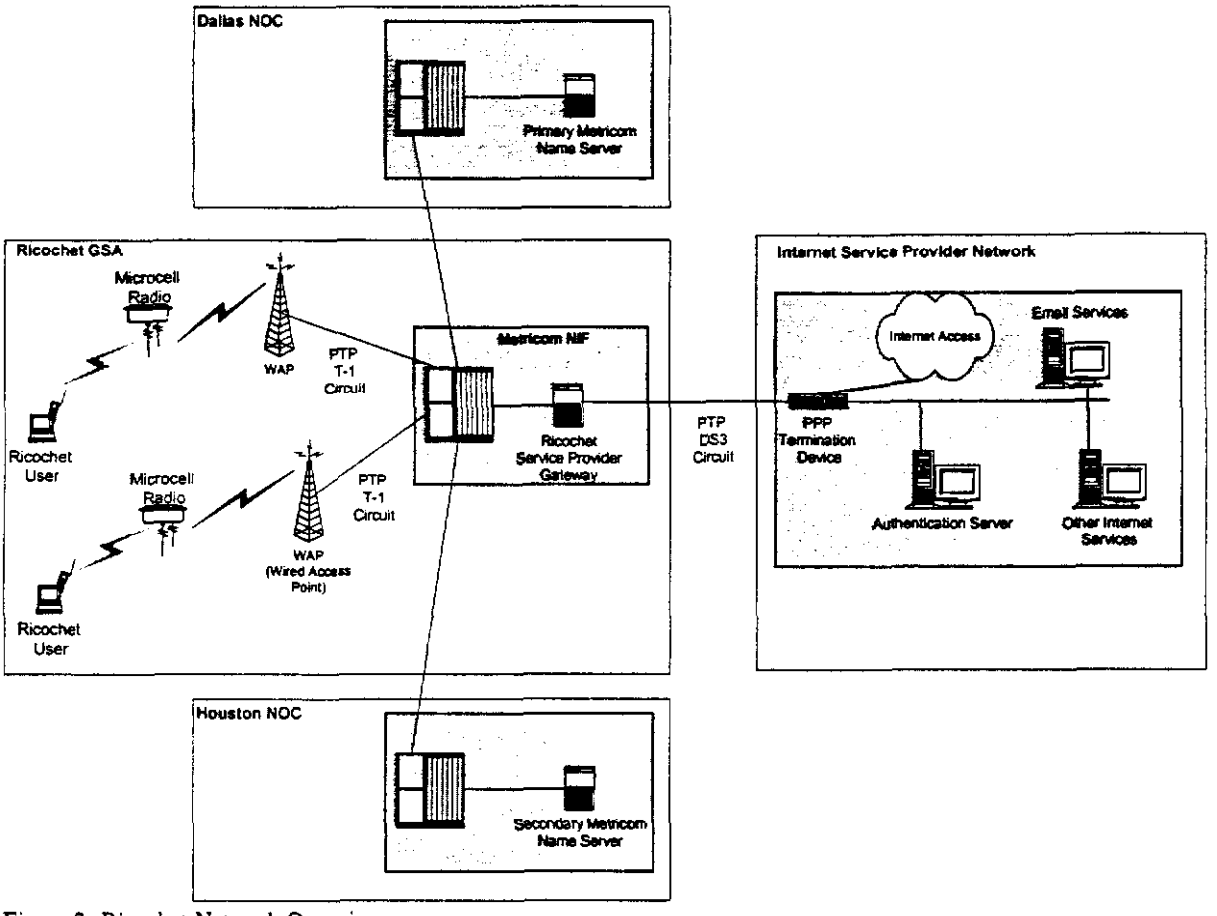

Figure 2: Ricochet Network Overview

2.1 Geographic Service Area (GSA)

The Ricochet service coverage area is divided by Geographic Service Areas (GSAs). The Ricochet Network in each GSA is composed of microcell radios, ISM WAPs, WCS WAPs, a Network Interconnection Facility (NIF), gateways, and a connection to the Network Operations Center (NOC).

2.2 Microcell Radio

Microcell radios communicate and pass data packets between one another, creating a mesh network of RF coverage in a GSA. Each GSA is covered by microcell radios that are typically mounted on streetlight or power poles in a grid pattern over the area.

2.3 Ethernet Microcell Radio

Ethernet microcell radios are located at WAP locations and are used to transmit data to and from the wired-line communication connections. The Ethernet microcell radios convert the data packets from RF MCDN format to wired IP MCDN format. The ISM Ethernet microcell radios use the ISM 900 MHz and 2.4 GHz frequency band; the WCS Ethernet microcell radios use the WCS 2.3 GHz frequency band.

2.4 Wired Access Point (WAP)

Wired Access Point (WAP) refers to a physical facility that connect the wireless part of the Ricochet network to the Ricochet Wide Area Network (WAN). The WAP cabinets contain specialized MCDN equipment and standard IP networking equipment to route data to and from the Ricochet Wide Area Network in the GSA. WAPs are commonly installed on building tops or towers. A WAP is connected to NIF via multiple Point-to-Point T-1 data circuits that are aggregated by the providers into Channelized DS3 circuits. The Channelized DS3 circuits are terminated on networking hardware located in the NIF. These Point-to-Point T-1 data circuits comprise the Wide Area Network in each GSA.

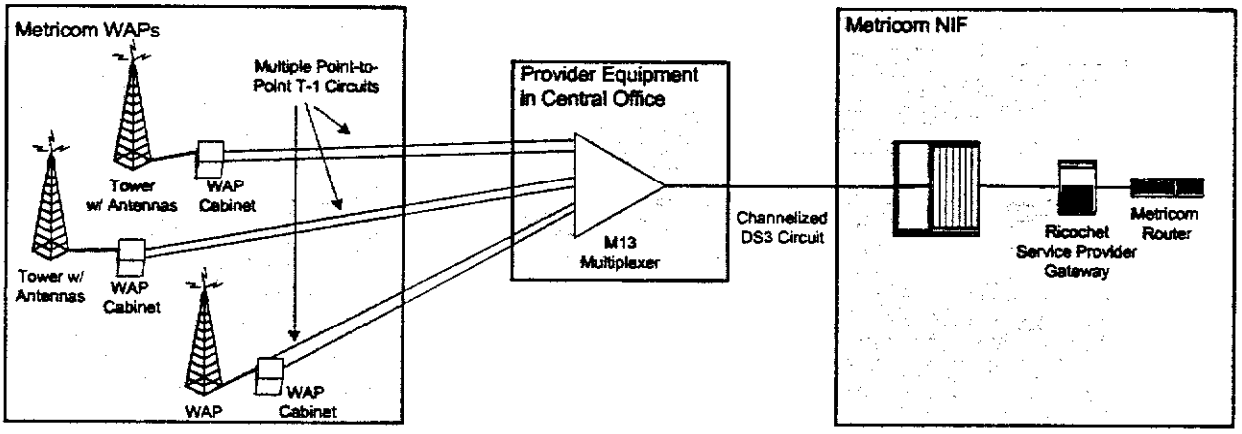

Figure 3: WAP to NIF Connectivity

2.5 Network Interconnection Facility (NIF)

The Network Interconnection Facility (NIF) is the hub of the Ricochet Wide Area Network for a GSA. A GSA can contain one or more NIFs. The Internet Service Provider Network physically connects their network to the Ricochet Network at the NIFs. Metricom provides these local connection points to the Internet Service Provider Networks within a GSA. The NIFs are located at collocation facilities provided by MCI WorldCom and other third-party collocation providers.

2.6 Ricochet Service Provider Gateway

The Ricochet Service Provider Gateways located in each NIF communicates with the Internet Service Provider Network via leased data communication circuits. These circuits are typically Point-to-Point T-1, DS3, or OC-3 data circuits. The Ricochet Service Provider Gateway converts the MCDN user data packets to IP user data packets. The IP user data packets are forwarded to the Internet Service Provider Network over the Point-to-Point DS3 data circuits. The virtual connection initiated by the Ricochet subscriber device is terminated at this point.

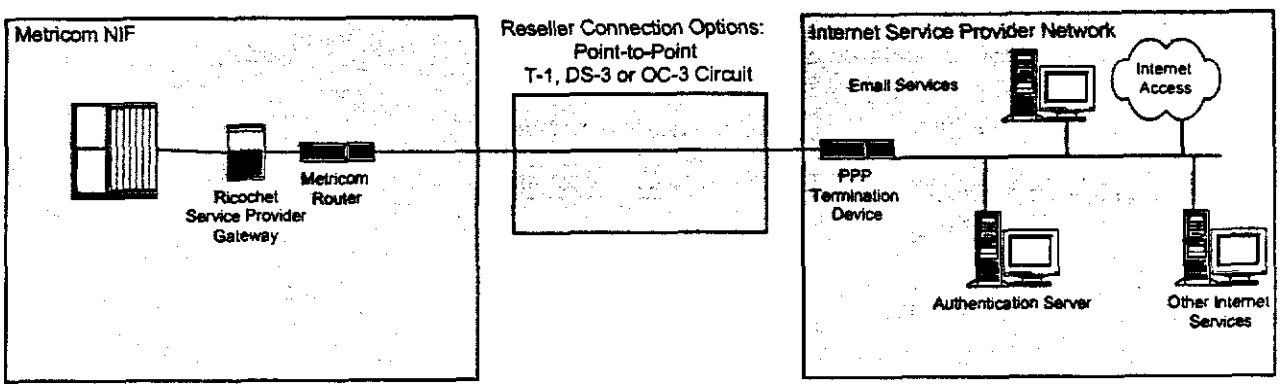

Figure 3: Internet Service Provide Network

3 Network Operations Center (NOC)

The Network Operations Center (NOC) is responsible for monitoring and proactively maintaining the daily operation and health of the Ricochet network. The NOC is also responsible for resolving any Wide Area Network or wireless connectivity problems with the Ricochet Network. There are two Network Operation Centers, a primary NOC located in Dallas, TX and a secondary NOC located in Houston, TX. The NOC also maintains a separate data communications network for network management traffic between the NIFs and both Network Operation Centers. This network is used to manage all hardware components of the NIFs and WAPs and all microcell radios that are part of the Ricochet Network.

3.1 Name Server (NS)

The Ricochet Name Server maintains access-control and routing information for every radio and service within the Ricochet Network. Every time an MCDN device (subscriber device, microcell radio, or service gateway) is powered on, it registers with the Name Server to verify it has network authorization and to announce its location within the network. Whenever an MCDN device requests a connection to another MCDN device or service, the request is validated by the Name Server, and, if authorized, the originator is provided with a network routing path to the requested destination. The Name Server validates all connection requests from Ricochet wireless modems.

After the Ricochet subscriber device has registered with the network, the user initiates a dial-up networking connection through their Ricochet subscriber device by entering a "PPP connection string" and initiating a PPP connection. The "PPP connection string" is an MCDN reference name that is looked up in the Name Server to determine the MCDN address of the device it references. In the case of a Ricochet Service Provider Gateway, the Name Server provides subscriber device a list of available Ricochet Service Provider Gateways in the GSA.